From: Darby, Thomas <Thomas.Darby@arcadis.com>
Sent: Tuesday, April 25, 2017 9:31:02 AM
To: Walker, Adelaide
Cc: Jeannie Martin; Trask (Cota), Jennine; Schnobrich, Matthew
Subject: RE: laurens FS

Addie,

The technologies included in both the FFS Work Plan and the FFS were developed to provide a list of the most applicable remedial technologies based on site conditions and previous remedial activities. The list reflected in the FFS included the same technologies discussed between 3M, Arcadis and DHEC during our previous discussion. While the several technologies you brought up are viable for consideration of solvents treatment, the following summarizes our perspective on their limited applicability to the site. While these could be highlighted as part of a comprehensive technology list in a conventional FS document, we felt that they didn't bear inclusion or more detailed consideration as part of the FFS. Please let us know if you have any additional questions on these once you've reviewed the following rationale.

ISCO

- Previous ISCO testing at the site during the late 1990s indicated that this technology exhibited limited effectiveness within the geology at the site. While the oxidant utilized at the time was Fenton's reagent and the world of oxidants has expanded considerably over the course of the past 1 – 2 decades, the nature of the geology at the site still presents several key challenges for any ISCO program. The first challenge is related to the presence of contaminants within the fine-grained material, which merits an injection reagent with sufficient residence time to promote treatment across advective/storage soil interfaces. Most oxidants (e.g., Fenton's, activated persulfate) exhibited relatively expedited consumption so would need to be injected routinely to sustain and promote treatment. The second primary challenge with any ISCO approach is related to the management of secondary byproducts. Persulfate (and Fenton's) will yield an elevated sulfate signature downgradient that could potentially discharge to the surface water, and both of these oxidants can also liberate labile metals that could result in similar management challenges. Consideration of permanganate as an oxidant would allow greater residence time, but would come with similar challenges related to secondary effects – in this case purple oxidant upgradient of a surface water body. Comparatively, the utilization of biological substrates (like the ERD approach considered) provides a greater degree of reagent and byproducts control and represents a food grade / degradable substrate to support natural processes.

Activated carbon

- We're reading a bit between the lines here but are assuming that you are implying a form of injectable activated carbon (AC) like the BOS100 or Plumestop products currently on the market. While these have been demonstrated effective at the bench-scale for solvents treatment (and these vendors have similar solvent-related case studies), neither of these options really represents a stand-alone destructive remedy for the mass currently in place. The first challenge is effective delivery – BOS100 needs to be done via high-pressure DPT and Plumestop (a solid particle) needs to be effectively advanced through either the weathered bedrock or the less permeable overlying saprolite which can strain and retain the AC particles and limit radial transport. This straining behavior can reduce overall permeability and limit the ability to redeliver organic substrates to sustain the biological treatment process (and perpetuate AC sorption capabilities). By comparison, the ERD treatment approach achieves the same overall objectives, relies on a substrate that can be effectively delivered into the subsurface using injection wells (a preferred method of delivery), and ultimately represents a means to achieve the targeted contaminant transformation processes. While the vendors of these materials tout the benefits of "enhanced degradation" of AC following injection, these reagents are still in their infancy and don't have the body of case study experience behind the other options included in the FFS.

ZVI

- We considered ZVI as an alternative initially as one way to accomplish the overall treatment objectives. This approach would leverage similar mechanisms as the ERD program (with the added abiotic treatment benefit), but requires a very different method of delivery. The primary downside of this approach is related to the required DPT delivery approach. While we would be able to effectively propagate the ZVI into the target vertical intervals, we wind up with significantly less even distribution compared to a well-based, low pressure injection application. The elevated pressure used to fracture the ZVI into the subsurface results in the development of preferential pathways within the soil formation and limits the overall control of reagent distribution. So what you encounter with these programs is

concentrated intervals where the reagent has been distributed, and intervals where no reagent delivery occurs – which runs the risk of leaving contaminants on the sideline. So from a comparison standpoint, the well-based methods are preferred here to maximize coverage and thereby reduce contaminant flux downgradient. Coupled with this benefit is the ability to re-use injection wells as part of a continued program to replenish remedial substrate as its consumed. Ultimately the well-based biological approach offered greater degree of engineering control, adaptive management, and a stronger overall technical approach.

Please let me know if you have any additional questions. If you would like to discuss further, we can schedule a call.

Thanks,

Tom

**** We moved. Please note new contact information below ****

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From: Walker, Adelaide [mailto:walkeras@dhec.sc.gov]
Sent: Friday, April 21, 2017 2:20 PM
To: Darby, Thomas <Thomas.Darby@arcadis.com>
Subject: laurens FS

question: Is there any reason why you didnt consider isco, activated carbon or zvi for the source areas?
thanks, Addie

Addie Walker
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